HOV

High Occupancy Vehicles

August 31, 1993

NEW JERSEY TURNPIKE AUTHORITY

P.O. Box 1121 New Brunswick, N.J. 08903 (908) 247-0900

September 3, 1993

Mr. James J. Snyder, Director
Division of Transportation Assistance
Policy and Planning
New Jersey Department of Transportation
1035 Parkway Avenue
CN 600
Trenton, NJ 08625

Mr. John D. Wilkins, Director
Service Performance
New Jersey Transit Corporation
One Penn Plaza East
Newark, New Jersey 07105-2246

RE: HOV Study

Dear Messrs. Snyder and Wilkins:

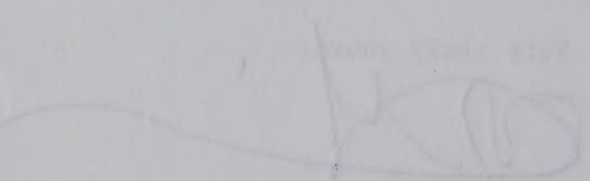
Enclosed for your information is the package of HOV materials distributed at the Authority's August 31, 1993 Commission Meeting. This package includes not only Parsons' final report, but also a copy of the resolution that was voted on and approved and other backup documents. I have also enclosed a copy of the technical appendix to Parsons' report.

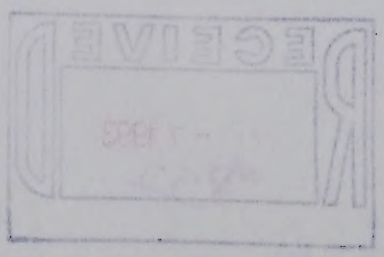
I would like to take this opportunity to thank you and your staff for the cooperation, open and frank discussions that were so instrumental in accomplishing our objectives over the past several months. I think our agencies, New Jersey and the public will all benefit from this effort.

Very truly yours,

Robert J. Grimm, P.E.
Senior Project Engineer

RJG:rp
Attachment
cc: J. J. Kessler
File





NEW JERSEY TURNPIKE AUTHORITY

RESOLUTION TO AUTHORIZE A COMMITMENT IN PRINCIPLE TO THE INSTALLATION OF HIGH OCCUPANCY VEHICLE LANES

WHEREAS, the policy of the United States of America, the State of New Jersey and the New Jersey Turnpike Authority (the "Authority") is to reduce air pollution in New Jersey by reducing total emissions of contaminants from vehicles travelling on state highways; and

WHEREAS, the State of New Jersey is required to enact transportation control strategies as part of its State Implementation Plan ("SIP") under the federal Clean Air Act, as amended, in order to reduce said emissions; and

WHEREAS, the New Jersey Department of Transportation ("DOT") and the New Jersey Department of Environmental Protection and Energy ("DEPE") are the state agencies responsible for drafting and submitting the SIP; and

WHEREAS, it is the objective of the Authority to assist the State of New Jersey in meeting its obligations under the Clear Air Act; and

WHEREAS, the Authority is engaged in widening the New Jersey Turnpike (the "Turnpike") between Interchanges 11 and 14 (the "Widening"); and

WHEREAS, the completion of the Widening is currently expected in December, 1995; and

WHEREAS, DOT and DEPE have recommended the installation of dedicated high occupancy vehicle ("HOV") lanes as a major feature of the Widening, for the purpose of reducing overall emissions of contaminants from vehicular traffic on the Turnpike; and

WHEREAS, the Authority is presently engaged in studying the technical and economic feasibility on installing such dedicated HOV lanes;

NOW, THEREFORE, BE IT RESOLVED BY THE NEW JERSEY TURNPIKE AUTHORITY, AS FOLLOWS:

Section 1. The Authority hereby commits in principle to install dedicated HOV lanes during specified peak hours only as a feature of the Widening, which commitment is subject to the following conditions:

A. That it is demonstrated to the satisfaction of the Authority, prior to the completion of the Widening, that safe entrances and exits to the proposed HOV lanes can be provided;

B. That it is demonstrated to the satisfaction of the Authority, prior to the completion of the Widening, that use of HOV lanes by high occupancy vehicles can be enforced adequately and safely;

C. That it is demonstrated to the satisfaction of the Authority, prior to the completion of the Widening, that the operation of the proposed HOV lanes can be made compatible with the Turnpike's Automated Traffic Surveillance and Control System ("ATSCS");

D. That it is demonstrated to the satisfaction of the Authority, prior to the completion of the Widening, that public support for the use of the proposed HOV lanes can be developed sufficiently through public hearings and other methods;

E. That it is demonstrated to the satisfaction of the Authority, prior to the completion of the Widening, that the Authority can meet the additional cost of installing the proposed new lanes as dedicated HOV lanes; and

F. That the amendment to the SIP, which the State of New Jersey is required to submit to the United States Environmental Protection Agency by November 15, 1993, contain the provision which is attached hereto as Exhibit A.

Section 2. The Executive Director of the Authority is hereby authorized and directed to take all steps necessary and desirable to implement the provisions of Section 1 hereof.

Section 3. Hereafter, the Authority may make further reviews to determine whether or not additional HOV lanes are appropriate at other locations on the Turnpike.

Section 4. This Resolution shall take effect immediately in accordance with the Authority Act of 1948, as amended.

I hereby certify the foregoing to be a true and correct copy of Resolution adopted at the Regular meeting of the Authority on August 31, 1993.

HERBERT I. OLARSCH
Secretary

EXHIBIT A

PROVISION OF THE STATE IMPLEMENTATION PLAN
FOR THE STATE OF NEW JERSEY
PROPOSED AMENDMENT, NOVEMBER 15, 1993

On the date for completing the Widening of the New Jersey Turnpike (the "Turnpike") between Interchanges 11 and 14 (the "Widening"), which date is anticipated currently as December 31, 1995, the New Jersey Turnpike Authority (the "Authority") will install dedicated high occupancy vehicle ("HOV") lanes which will operate between said interchanges during specified peak hours only, provided that the conditions outlined in the Authority's Resolution as approved at the Commission Meeting of August 31, 1993 (a copy of which is attached hereto) have been met by that date.

State of New Jersey
Department of Environmental Protection and Energy
Policy and Planning
CN 418
Trenton, NJ 08625-0418
Tel. # 609-292-1254
Fax. # 609-777-0942

Jeanne M. Fox
Acting Commissioner

Richard V. Sinding
Assistant Commissioner

August 27, 1993

Mr. Donald L. Watson
New Jersey Turnpike Authority
PO Box 1121
New Brunswick, NJ 08903

Dear Mr. Watson:

It was a pleasure to meet with you this past Tuesday to discuss the New Jersey Turnpike Authority's plans for a High Occupancy Vehicle (HOV) lane.

We have consulted with the U.S. Environmental Protection Agency and the N.J. Department of Transportation, and we are in agreement that the Authority's "commitment in principle" to implement the HOV lane should be included in the 1993 State Implementation Plan. Further, we support the Authority's resolution to adopt this commitment in principle.

We request that you keep our agencies informed on the progress of various ongoing studies regarding the feasibility of implementing the HOV lane and other measures to reduce emissions of contaminants from vehicular traffic on the New Jersey Turnpike. If these studies indicate that the HOV lane is not feasible, we would entertain further discussion on possible contingencies.

Thank you for your cooperation. I look forward to working with you and the Turnpike Authority Commissioners in pursuit of our common goal of achieving clean air for all New Jersey citizens.

Sincerely,

Richard V. Sinding
Assistant Commissioner

c: Scott Weiner
Christine Johnson
Conrad Simon
John Elston
Chris Salmi

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To Don Watson	From Rick Sinding
Co. Turnpike Auth.	Co. Policy Planning
Dept.	Phone # 2-1254
Fax #	Fax #

IN REPLY PLEASE REFER TO

State of New Jersey
DEPARTMENT OF TRANSPORTATION

THOMAS M. DOWNS
COMMISSIONER

1035 PARKWAY AVENUE
CN 600
TRENTON, NEW JERSEY 08625

August 17, 1993

Donald Watson
Executive Director
New Jersey Turnpike Authority
P.O. Box 1121
New Brunswick, NJ 08903

Dear Don:

I appreciated the opportunity of meeting with you on Monday, August 16 and being briefed by Parsons-Brinckerhoff on the HOV policy issue. I had an opportunity to review the issues with Tom along with your proposal. Tom did not express concern about the overall approach of making a commitment in principal to a HOV lane pending an investigation into a number of operational questions. However, he wants to see the actual resolution that would be voted on by the Board 5 or 6 days prior to the Board meeting. I assume there is no problem with this request.

Sincerely yours,

Christine M. Johnson
Assistant Commissioner
Policy and Planning

R E P O R T

to

CHAIRMAN AND MEMBERS OF

NEW JERSEY TURNPIKE AUTHORITY

David J. Goldberg, Chairman
Frank E. Rodgers, Vice Chairman
Leonard Cohen, Treasurer
Clay Constantinou, Commissioner
Thomas M. Downs, Commissioner
Raymond M. Pocino, Commissioner

on the

FEASIBILITY OF INSTALLING HOV LANES ON THE NEW JERSEY TURNPIKE

by

DONALD L. WATSON
EXECUTIVE DIRECTOR

DATE: August 31, 1993

INTRODUCTION

In a report to Governor Jim Florio dated December 12, 1990, the New Jersey Transportation Executive Council (TEC) recommended that high occupancy vehicle (HOV) lanes be evaluated and then implemented on the Turnpike between Interchanges 8A and 14. As a long-term strategy, the TEC further recommended that the Turnpike Authority explore extending the HOV lanes to Interchange 16E.

These recommendations were prompted by:

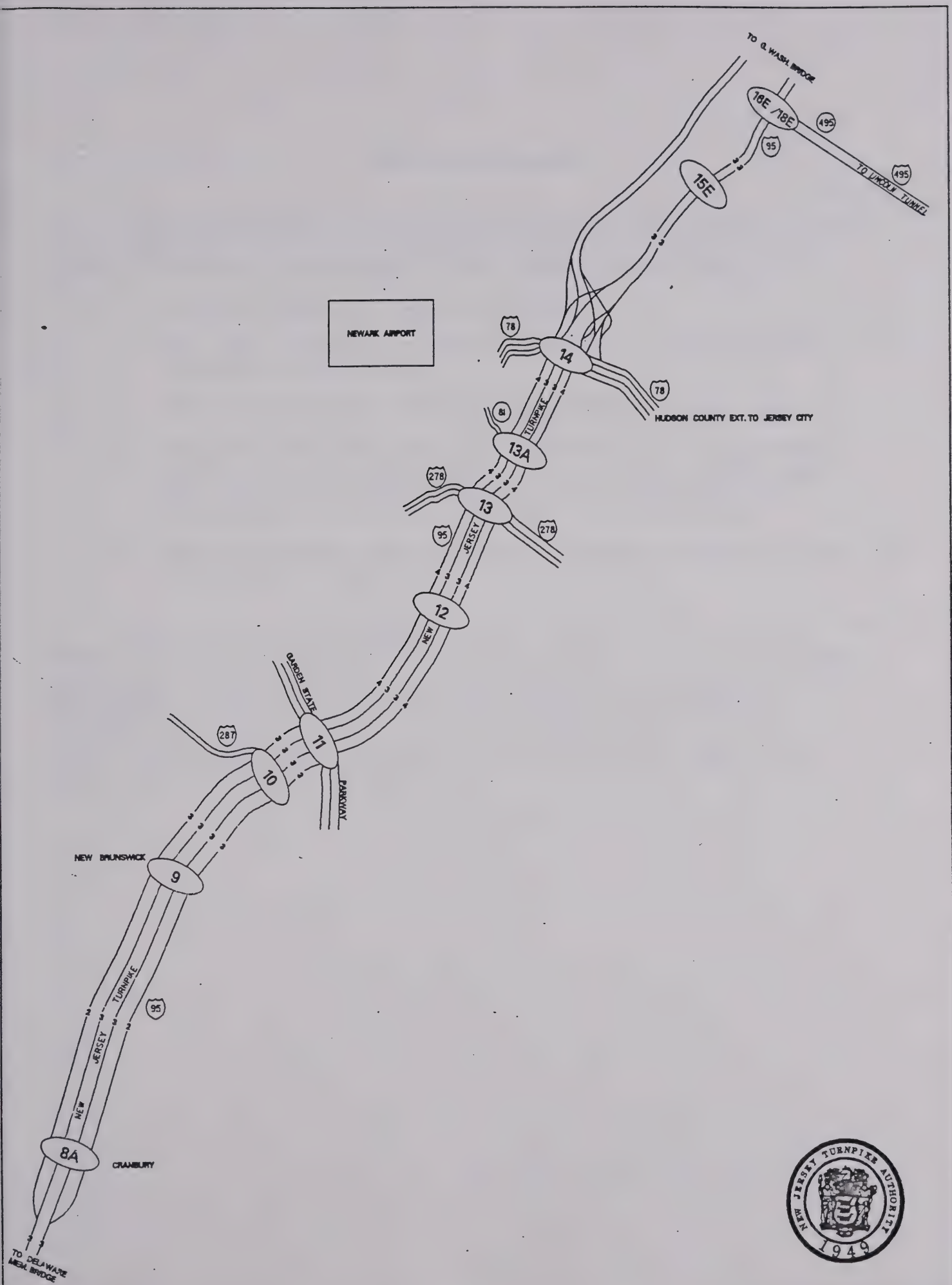
- Awareness that the Turnpike Authority was working toward a major capital improvement program which included widening the Turnpike between the Garden State Parkway (Interchange 11) and Newark Airport (Interchange 14).

- The premise that HOV lanes can move more people faster in fewer cars, thus reducing vehicle exhaust emissions. New Jersey does not meet federal air quality standards, and more than half of its air pollution problems stem from the automobile.

Early in 1991 the Authority obtained final approval to proceed with construction of its improvement program. The widening project - from 12 lanes to 14 lanes for 13 miles - is now underway and scheduled for completion at the end of 1995.

In January 1992 the Authority engaged the consulting firm of Parsons Brinckerhoff-FG, Inc. to study the feasibility of implementing the Executive Council's recommendations. A report of the first phase of this study, primarily covering traffic considerations, has been submitted. A separate report from Roper and Associates, a firm known nationally for its extensive experience with HOV lanes, has also been submitted.

This report to the Commissioners summarizes the findings of these two organizations regarding viability of HOV lanes on the Turnpike from the traffic perspective and outlines some critical questions which remain to be answered.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TO LINCOLN TUNNEL
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TO DELAWARE MEM. BRIDGE
NEW JERSEY TURNPIKE AUTHORITY
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EXECUTIVE SUMMARY

Intensive analysis from a traffic perspective indicates that installation of dedicated HOV lanes as a feature of the current widening between Interchange 11 and Interchange 14 would:

- Produce tangible travel benefits.
- Not cause deterioration in service to general purpose (non-HOV) lane users.
- Produce modest but positive improvement in air quality.
- Have the greatest chance of success of any alternative studied because no existing lane would be "taken away". (No installation of HOV lanes on a freeway through conversion of existing lanes has ever succeeded.)
- Have the least negative impact on annual revenue of any HOV alternative studied.

Despite these advantages, serious design and operational questions remain, including the issues of safe entrances and exits, enforcement, compatibility with the Turnpike's automated traffic management system, construction cost and public acceptance. I therefore recommend that the Turnpike Authority approve a "commitment in principle", subject to satisfactory resolution of these outstanding questions, for inclusion of HOV lanes on the Turnpike in New Jersey's 1993 SIP.

THE TRAFFIC TEST

From a purely traffic perspective, the target of installing HOV lanes on a highway is reduction or deferment of congestion, especially during peak commuter travel hours. Congestion along a freeway is generally considered to exist when traffic volumes exceed 1,800 passenger cars or their equivalent per lane in the peak hour. Experience indicates commuters begin to shift from single occupancy vehicles to high occupancy vehicles or buses when average speeds fall to 30 miles per hour or less over significant distances during the peak hour.

Traffic volumes, vehicle classifications and occupancy information were developed and projected to 1996 - when the widening will be in service - and 2006, ten years later. The traffic volumes showed:

- No congestion, either in 1996 or 2006, between Interchanges 8A and 11.
- No congestion in 1996 between Interchanges 11 and 16E, except in the PM peak hour between Interchanges 14 and 16E.
- Congestion in 2006 between Interchanges 11 and 16E during both peak hours.

This analysis indicates that installation of HOV lanes between Interchanges 8A and 16E would not have much impact on congestion in 1996 because traffic demand would not produce any except once a day on the northernmost segment. However, traffic demand would produce congestion twice a day over a much longer stretch of the Turnpike, including the section being widened, during the following decade. Therefore, since HOV lanes on the Turnpike have the potential to defer congestion which traffic projections indicate would otherwise occur by 2006, further consideration of installing them on the Turnpike is warranted.

THE USE TEST

Central to the issue of HOV lane viability is the question of whether the lanes will be used. The initial number of HOV's traveling in a dedicated HOV lane must be large enough to prevent that lane from looking empty. Otherwise it may be viewed as another governmental indulgence in conspicuous waste and, unless physically prevented, single occupancy vehicles (SOV's) will start using it.

In general, the minimum number of HOV's during the peak hour should be about 700 passenger cars or their equivalent. This number is good for lanes restricted to buses and cars with at least one passenger (2+), or buses and cars with at least two passengers (3+). There should be at least 100 buses in the peak hour for bus only lanes or mixed lanes.

But, the number cannot be so large as to cause the level of service on the HOV lane to become worse than on the adjacent general purpose lanes, thereby destroying any incentive to switch from SOV's to HOV's. The upper limit is 1600 passenger cars or the equivalent.

Projections of vehicle volumes in 1996 indicate that as of the day dedicated HOV lanes are opened, the vehicles eligible to use them would be:

ELIGIBLE USERS	N.B.-A.M.	S.B.-P.M.
3+ & Bus	700	900
2+ & Bus	2,100	2,700
Bus Only	300	200

These numbers would increase by about 100 in each instance, shortly after HOV lanes became available, due to the switching of SOV's to HOV's.

The analysis indicates there would be enough, but not too much, traffic on HOV lanes if restricted to buses and cars with at least two passengers. Allowing cars with only one passenger would overload the lanes.

The projected use of HOV lanes warrants their further consideration.

OTHER BENEFIT TESTS

Other questions relating to HOV lane viability include:

- Will HOV lanes improve the efficiency (person throughput) of a highway by increasing its ability to move people because the HOV lanes carry a larger average number of people than general purpose lanes?
- Will HOV users save travel time compared with SOV's in the general purpose lanes? There should be a savings of at least one minute per mile or at least three minutes per trip.
- Does implementation of HOV lanes cause a deterioration in the level of service on the general purpose lanes because they would carry significantly higher traffic volumes?

In order to answer these questions, as well as the question of vehicle use, some 36 scenarios involving various combinations of HOV lane treatments and vehicle eligibility along with a Do Nothing scenario, were considered. The scenarios were then reduced to the five alternatives shown in the MATRIX on page 7 and analyzed in more detail.

THE PUBLIC ACCEPTANCE TEST

Experience has shown that positive public support is essential to the success of dedicated HOV lanes. There has not been a successful project involving any significant length of freeway where an HOV lane was created by converting (taking away) an existing general purpose lane. Where the Parsons Brinckerhoff study says merely, "it appears it would be difficult for a lane conversion strategy to work", Roper categorically recommends that the Turnpike avoid taking a lane "or even creating the appearance of same" to create an HOV lane. The need for using an existing lane is also shown in the MATRIX on page 7.

The MATRIX shows:

- Insufficient HOV's under the first two alternatives to justify dedicated lanes between Interchanges 8A and 11.
- The fourth alternative causes deterioration of traffic service on the general purpose lanes between Interchanges 14 and 16E during the AM peak period.
- Only the third alternative - a single lane in each direction between Interchanges 11 and 14 restricted to buses and cars with at least two passengers - does not require using an existing lane because this is the section being widened.

Further analysis indicated that under the third alternative, after the new lanes were in use as dedicated HOV lanes, travelers on the general purpose lanes would lose only about two seconds on this segment of their trip.

Therefore, on the basis of projected traffic volumes, usage, public acceptance and other user benefits, installation of dedicated HOV lanes according to this third alternative would appear to have the most viability.

AIR QUALITY

In addition to reducing congestion, a major influence on the Transportation Executive Council's 1990 recommendation was, and continues to be, anxiety over the State's failure to meet federal air quality standards. The Turnpike Authority is in agreement with the drive to improve air quality by reducing vehicle exhaust emissions.

NEW JERSEY TURNPIKE HOV STUDY

VIABILITY MATRIX

1996

HOV SCENARIO	NUMBER OF HOV LANES	STUDY SEGMENT INTERCHANGE LIMITS	VEHICLE THROUGHPUT [HOV lane carries more than 700 vehicles or 100 buses]		PERSON THROUGHPUT [HOV lane carries more people than one general purpose lane]		TRAVEL TIME SAVINGS [Provides at least 3 minute savings]		DOESN'T TAKE AWAY AN EXISTING LANE	DOESN'T DETERIORATE OPERATIONS ON GENERAL PURPOSE LANES VERSUS DO NOTHING SCENARIO	
			AM	PM	AM	PM	AM	PM		AM	PM
SINGLE LANE BUS ONLY HOV INTERCHANGES 8A TO 16E	1	8A to 11	NO	NO	YES	YES	YES	YES	NO	YES	YES
	1	11 to 14	YES	YES	YES	YES			YES	YES	YES
	1	14 to 16E/18E	YES	YES	YES	YES			NO	YES	YES
SINGLE LANE 3+ & BUS HOV INTERCHANGES 8A TO 16E [Same as above except HOV lane includes vans and cars with 3 or more occupants]	1	8A to 11	NO	NO	YES	YES	YES	YES	NO	YES	YES
	1	11 to 14	YES	YES	YES	YES			YES	YES	YES
	1	14 to 16E/18E	YES	YES	YES	YES			NO	YES	YES
SINGLE LANE 3+ & BUS HOV MODIFIED INTERCHANGES 11 TO 14 [HOV lane limits are between Interchanges 11 and 14]	1	11 to 14	YES	YES	YES	YES	YES	YES	YES	YES	YES
COMBINATION 1 & 2 LANE 2+ & BUS HOV INTERCHANGES 8A TO 16E [Single lane: 8A to 11] [2 lanes: 11 to 14] [Single lane: 14 to 16E]	1	8A to 11	YES	YES	YES	YES	YES	YES	NO	YES	YES
	2	11 to 14	YES	YES	YES	YES			NO	YES	YES
	1	14 to 16E/18E	YES	YES	YES	YES			NO	NO	YES
INNER BARREL 2+ & BUS HOV & TRUCKS INTERCHANGES 8A TO 16E [HOV vehicles with 2 or more occupants plus buses and trucks]	3	8A to 11	YES	YES	YES	YES	YES	YES	NO	YES	YES
	3	11 to 14	YES	YES	YES	YES			NO	YES	YES
	1	14 to 16E/18E	YES	YES	YES	YES			NO	YES	YES

The five HOV lane alternatives were compared with a "Do Nothing" scenario in terms of carbon monoxide, hydrocarbon, and nitrogen oxide. Only Alternative 3 - a single lane in each direction between Interchanges 11 and 14 - showed a reduction in all three pollutants during both AM and PM peak periods.

OPERATING COSTS

Under any HOV scenario there is the likelihood of revenue loss as motorists join carpools and switch to buses. This could be less than estimated if drivers on parallel routes switch to the Turnpike because the HOV lanes are attractive or there is an overall improvement in traffic quality.

The estimated annual revenue losses range from a low of $600,000 for Alternative 3 to a high of $5,400,000 for Alternative 1 (bus only).

REMAINING QUESTIONS

The analysis performed to date, almost entirely on the basis of traffic information, indicates that installing HOV lanes on the Turnpike would result in traffic benefits (moving more people in fewer vehicles of overall reduced travel time) and in modest but positive improvement in air quality.

The data as well as a wealth of experience elsewhere, indicates the section between Interchanges 11 and 14 has the greatest chance of public acceptance -- and therefore success -- because no lane would be "taken away".

But a number of extremely critical questions remain to be answered before any final decision can be recommended.
These are:

- Can safe entrances and exits to and from HOV lanes be provided?
- Can the use of HOV lanes only by eligible vehicles be adequately and safely enforced?
- Can HOV lanes be operated in a manner compatible with the Turnpike's Automated Traffic Surveillance and Control System?
- Can sufficient public support be developed for HOV lanes?
- What are the additional construction, maintenance and operating costs of installing HOV facilities?

CONCLUSION

New Jersey's 1993 State Implementation Plan (SIP) for meeting federal air quality standards must be submitted to the Environmental Protection Agency by November 15th. The New Jersey Department of Transportation, responsible for assisting the New Jersey Department of Environmental Protection and Energy in developing the transportation elements of the SIP, is anxious that the SIP include a statement regarding HOV lanes on the Turnpike.

Studies to date have shown HOV lanes between Interchanges 11 and 14 are viable from a traffic perspective, would produce travel and air quality benefits, and would stand the best chance of public acceptance of all the possibilities that were investigated.

Nevertheless, serious questions remain. It is essential to resolve the issues they raise, and this cannot be accomplished in time for inclusion in the 1993 SIP.

It is, therefore, recommended that the Commissioners approve a "commitment in principle" to install dedicated HOV lanes for operation during peak hours only between Interchange 11 and Interchange 14.

It is further recommended that this "commitment in principle" be subject to resolution of the remaining questions to the satisfaction of the Authority prior to the completion of the ongoing widening.

And, it is further recommended that this commitment, and the conditions to which it is subject, be contained in New Jersey's 1993 SIP.

Technical Report

HOV Study
New Jersey Turnpike
Interchange 8A to
Interchange 16E/18E

August 1993

submitted by:

Parsons Brinckerhoff - FG, Inc.
Texas Transportation Institute
Pacific Rim Resources

submitted to:

New Jersey Turnpike Authority

HOV STUDY
New Jersey Turnpike
Interchange 8A to Interchange 16E

EXECUTIVE SUMMARY

The New Jersey Turnpike is the major north-south artery in the State serving all classes of vehicles. The portion of the Turnpike in central and northeastern New Jersey, designated I-95, serves extremely heavy volumes of automobiles, trucks, and buses. In response to the heavy volumes of commuter traffic carried by the Turnpike, the New Jersey Transportation Executive Council recommended that high occupancy vehicle (HOV) lanes be evaluated and implemented between Interchanges 8A and 14. As a long term strategy, the Council further recommended that the Turnpike Authority explore extending HOV lanes to Interchange 16E. These recommendations were made because HOV lanes have the ability to move more people faster in fewer vehicles, thus offering the potential for a time savings for commuters. Faster overall travel speeds, coupled with incentives to rideshare and take transit, can result in reduced vehicle exhaust emissions. Federally mandated air quality standards in the 1990 Clean Air Act Amendments are forcing governmental agencies to consider measures to reduce emissions. Over half of New Jersey's air pollution problems stem from the automobile. Since New Jersey is currently categorized as a non-attainment state with respect to the new air quality standards, it is appropriate that studies be undertaken to determine the impact of increased carpooling, vanpooling, and bus transit use through implementation of HOV lanes.

The Turnpike Authority has decided to study the viability of HOV treatments along its facility. Timing is critical for this study because of the ongoing widening program between Interchange 11 and Interchange 14, to be completed by 1996. Consequently, there is a need to analyze traffic operations and evaluate HOV priority treatments at this time. If HOV treatments are found to be viable, there will be sufficient time to incorporate HOV lanes into the current construction program to avoid future conversion of general purpose traffic lanes into HOV lanes.

The purpose of this study is to assess the viability of implementing priority treatment measures for high occupancy vehicles (HOVs) along the New Jersey Turnpike between Interchanges 8A and 16E. This assessment includes evaluations of various HOV treatments with respect to traffic, operational, air quality, and toll revenue issues that can affect feasibility.

The goals of this study are to:

- Conduct an objective assessment to determine the viability of implementing HOV priority treatments that maximize the movement of people in buses, carpools and vanpools, while minimizing negative impacts on Turnpike operations
- Evaluate alternative HOV scenarios that meet viability criteria

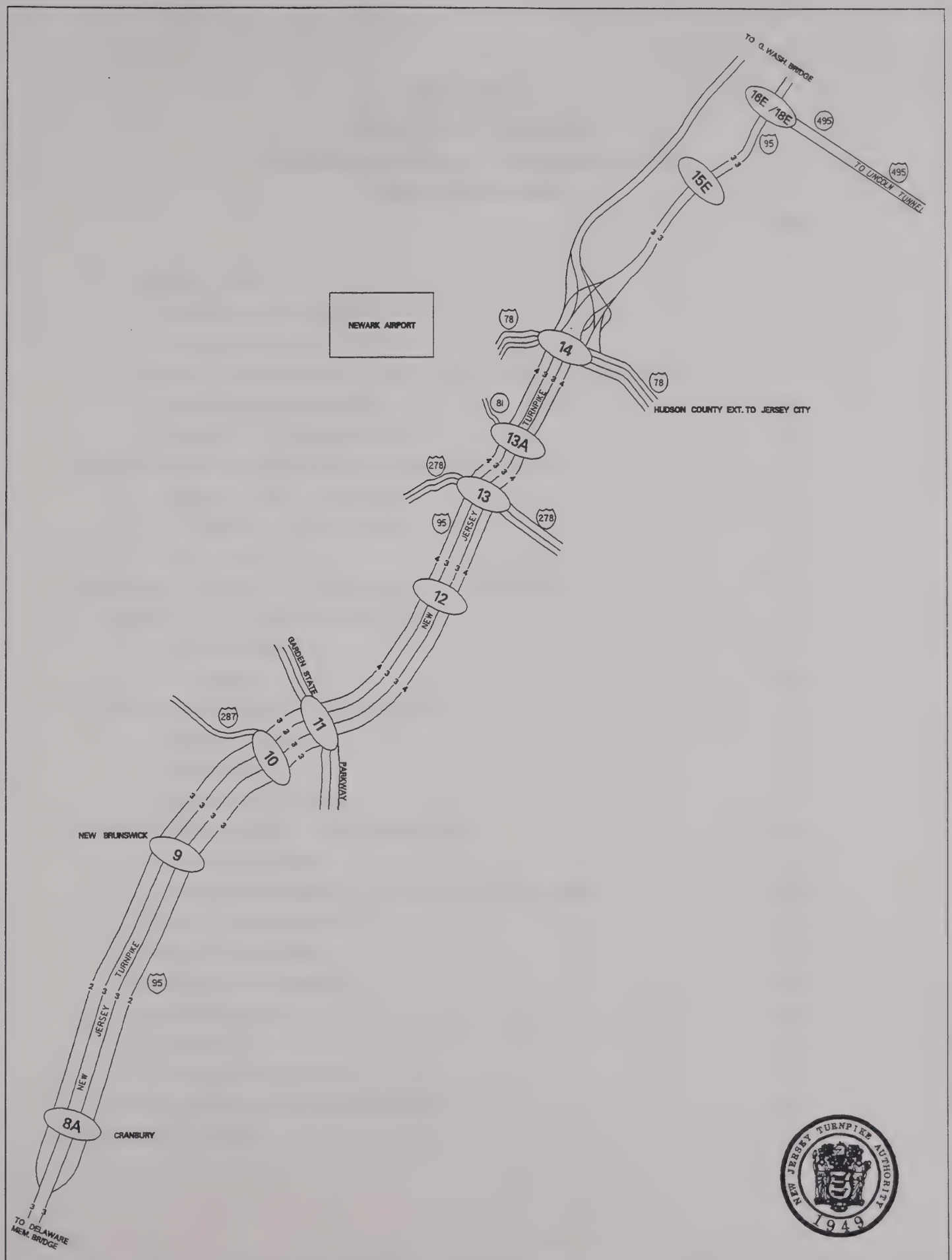
A multi-agency committee representing the New Jersey Turnpike Authority, the New Jersey Department of Transportation, and New Jersey Transit reviewed traffic analyses for a range of HOV lane treatments and vehicle eligibility to short list the following HOV scenarios for further study:

- Single Lane Bus Only HOV
- Single Lane 3+ & Bus HOV
- Single Lane 3+ & Bus HOV Modified (between Interchanges 11 and 14 only)
- Combination 1 & 2 Lane 2+ & Bus HOV
- Inner Barrel 2+ & Bus HOV & Trucks

All of these HOV scenarios appear to be operable, albeit at varying levels of operational difficulty and with different impacts on the general purpose lanes. Viability appears to be borne out for consideration of a single HOV lane between Interchanges 11 and 14. Before any commitments can be made, however, more detailed analyses must be performed regarding capital and operation costs, geometrics, access and egress, enforcement, and safety. As a toll facility, HOV treatments on the Turnpike need to address several issues not encountered on free controlled access facilities. They are:

- Toll plaza operations and advanced technology for electronic vehicle detection and toll collection
- Integration of toll plaza operations with operations on the mainline roadways of the Turnpike
- Revenue impacts
- Turnpike Automatic Traffic Surveillance and Control (ATSC) System

The New Jersey Turnpike is a unique facility in terms of both its design and especially its operation. Potential HOV treatments must be compatible with the unique characteristics of the facility and in conformance with the policies and requirements of the New Jersey Turnpike Authority.



HOV Study
New Jersey Turnpike
Interchange 8A to Interchange 16E
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1.0 INTRODUCTION

A report to the Governor from the New Jersey Transportation Executive Council ("Recommendations for Northeastern New Jersey," December 12, 1990) includes recommendations to evaluate and implement high occupancy vehicle (HOV) lanes on the Turnpike between Interchanges 8A and 14 with possible extension to Interchange 16E. These recommendations were made because HOV lanes have the ability to move more people faster in fewer vehicles, thus offering the potential for a time savings for commuters. Faster overall travel speeds, coupled with incentives to rideshare and take transit, can result in reduced vehicle exhaust emissions. Federally mandated air quality standards in the 1990 Clean Air Act Amendments are forcing governmental agencies to consider measures to reduce emissions. Since New Jersey is currently categorized as a non-attainment state with respect to the new air quality standards, it has legislated an Employer Trip Reduction Program. The legislation requires companies with 100 or more employees at one site to increase average vehicle occupancy by 25 percent. Implementation of HOV lanes encourages formation of carpools and vanpools along with greater bus transit ridership, thus increasing vehicle occupancy.

As owner of the major north - south artery in New Jersey, the Turnpike Authority decided to study the viability of HOV treatments along its facility. Timing is critical for this study because of the ongoing widening program between Interchange 11 and Interchange 14, to be completed by 1996. There is a need to analyze traffic operations and evaluate HOV priority treatments at this time. If HOV treatments are found to be viable, there will be sufficient time to incorporate HOV lanes into the current construction program to avoid future conversion of general purpose traffic lanes into HOV lanes.

1.1 Study Understanding

The New Jersey Turnpike is considered to be one of the best managed facilities in the country, with activities underway that include developing state-of-the-art improvements to its existing automatic traffic surveillance and control (ATSC) system and a widening program between Interchanges 11 and 14 that will enhance flexibility in managing traffic demands. Simultaneously, transportation and environmental policies from the federal and state levels are encouraging the study of strategies that will promote more efficient roadway use and improvements to air quality by moving more people in fewer vehicles. The Turnpike Authority recognizes that HOV treatments can be instrumental in supporting such policies.

This study offers some unique challenges with respect to the methods that HOV treatments have been studied and implemented elsewhere. In other viability studies, the project corridors generally have not offered both a dual roadway system and real time traffic control and management through the use of changeable message signing.

Both attributes exist on the Turnpike. Changeable message signing has enhanced the Turnpike's ability to balance flow between the inner and outer roadways, respond to incidents, and provide maintenance functions more effectively.

1.2 Study Goals and Purpose

The purpose of this study is to assess the viability of implementing priority treatment measures for high occupancy vehicles (HOVs) along the New Jersey Turnpike between Interchanges 8A and 16E in accordance with recommendations of the Governor's Transportation Executive Council. This assessment includes evaluations of various HOV treatments with respect to traffic, operational, air quality, and toll revenue issues that can affect feasibility.

The goals of this study are to:

- Conduct an objective assessment to determine the viability of implementing HOV priority treatments that maximize the movement of people in buses, carpools and vanpools between Interchanges 8A and 16E, while minimizing negative impacts on Turnpike operations
- Evaluate alternative HOV scenarios that meet viability criteria

Findings from this study must be considered within the context of the New Jersey Turnpike Authority's Automatic Traffic Surveillance and Control (ATSC) system and current improvement programs, including roadway widening projects between Interchanges 11 and 14. It is necessary to integrate ATSC and HOV planning because they are linked in terms of:

- operational considerations
- variable message signing and motorist information
- diversions/traffic management
- toll plaza design, operations, and security, including future provision for electronic toll collection (ETC) at toll booths

2.0 TURNPIKE USER AND NATIONAL TOLL FACILITY SURVEYS

2.1 Turnpike User Survey

A survey was conducted by the New Jersey Turnpike Authority and Pacific Rim Resources, Inc. during May 1992. Objectives of this survey included the following:

- Assess current public perceptions of transportation problems along the Turnpike
- Obtain feedback from the public about their perceptions of the effectiveness of HOV treatments
- Assess current public opinion about potential HOV treatments
- Provide information to help assess market potential for HOV treatment along the Turnpike
- Obtain information on commuter travel characteristics such as trip duration and vehicle occupancies

Information from the survey will be used in developing the marketing plan and public communication program that would be required if HOV priority treatments are found to be feasible.

2.2 National Toll Facility Survey

A literature review was conducted by the Texas Transportation Institute to identify examples of HOV measures on toll facilities, and to obtain basic information about those examples. Additionally, a telephone survey was conducted by the Institute with representatives from agencies responsible for toll roads, bridges, and tunnels throughout the country. The survey was intended to verify and update the basic information gathered from the published literature, to obtain additional information concerning the experiences with HOV strategies, and to identify other HOV projects and those in the planning stage.

A number of representatives provided information on the reasons for implementing the HOV toll projects. Many of the projects in California, Delaware, New York, and New Jersey were implemented in the 1970s in response to the energy crisis and the Arab oil embargo. The focus of these projects was to encourage greater utilization of all forms of high-occupancy vehicles to reduce gasoline consumption and to better manage facilities that were at or near capacity.

The conclusion of the survey is that very little information is available on the number of commuters using HOV priority facilities, the impact these facilities have had on influencing a change in commuting behavior, or the financial impact on the toll agencies.

3.0 EXISTING AND PROJECTED TRAFFIC VOLUMES

The New Jersey Turnpike is the major north-south artery in the State serving all classes of vehicles. The portion of the Turnpike in central and northeastern New Jersey from Interchange 8A to Interchange 16E, designated I-95, serves extremely heavy volumes of automobiles, trucks and buses destined to major employment, industrial, residential and recreational centers in Newark, the Hackensack Meadowlands, the Hudson River Waterfront, New York and points beyond. It also serves major transportation hubs -- rail facilities, Newark International Airport, Port Newark, and Port Elizabeth -- and interconnecting interchanges with I-78, I-278, I-280, I-287, Route 1, Route 3, Route 9, Route 18, Route 22, and the Garden State Parkway. Present transit use on the Turnpike is high with about 300 peak hour buses traversing the distance between Interchanges 11 and 14. Most of these are commuter buses accessing employment sites in Newark, Hoboken, Jersey City, and New York City. The Turnpike is also the State's primary artery for goods movement with close to 14,000 trucks per day using portions of the Turnpike within the study limits. Existing and projected traffic volumes were developed for the Turnpike between Interchanges 8A and 16E for the northbound AM peak period and the southbound PM peak period.

3.1 Existing Traffic Volumes

Traffic volumes, vehicle classifications, and occupancy data were determined from counts performed during April 1992, and data obtained from the New Jersey Turnpike Authority. Northbound AM peak hour (7 to 8 AM) volumes varied from 3,400 vehicles south of Interchange 8A to 9,800 vehicles north of Interchange 13. Bus volumes varied from 13 south of Interchange 8A to 180 north of Interchange 13 with most buses entering at Interchange 11 (78) and exiting at Interchange 16E (155). Peak bus volumes are actually higher, however, the peak hour for buses does not coincide with the peak hour for total vehicular volumes. There are significant numbers of vehicles on the Turnpike carrying more than one person (HOVs). The maximum number of peak hour HOVs are 1,580 with two or more people per vehicle. The maximum number of peak hour HOVs with 3 or more people is 330.

Southbound PM peak hour (4:45 to 5:45 PM) volumes varied from 3,400 vehicles south of Interchange 8A to 10,100 vehicles north of Interchange 13. Bus volumes varied from 16 south of Interchange 8A to 107 north of Interchange 13. Most buses enter the Turnpike at Interchange 16E (96) and exit at Interchange 11 (53). As during the AM peak period, the total vehicular peak versus the bus peak do not coincide. The maximum number of peak hour HOVs is 2,230 with two or more people. The maximum number of peak hour HOVs with 3 or more people is 680.

3.2 Projected Traffic Volumes

Traffic was projected to 1996, the year of expected opening of the fourth lane between Interchanges 11 and 14, using an annual growth factor of 2.5 percent. The traffic projections were used to assess HOV lane viability and to analyze potential HOV scenarios. Projected northbound volumes for the AM peak hour vary from 3,800 vehicles south of Interchange 8A to 10,900 vehicles north of Interchange 13. Projected southbound PM peak hour volumes vary from 3,800 vehicles south of Interchange 8A to 11,100 vehicles north of Interchange 13.

Traffic also was projected to year 2006 to assess HOV lane viability. A growth factor of 2.0 percent per year was used to project traffic from 1996 to 2006 assuming access to the Turnpike was not constrained by capacity limitations on the arterials interchanging with the Turnpike.

4.0 HOV LANE VIABILITY

The major factor for establishing the viability of implementing an HOV lane along a facility is recurring traffic congestion. Congestion along a freeway is generally considered to exist when traffic volumes exceed 1,800 passenger car equivalents per lane (PCEPL) in the peak hour. This volume is the threshold figure used by the Turnpike Authority to shift traffic between the inner and outer barrel roadways and between the east and west spurs to balance traffic flows over the dual roadways and minimize overall traffic congestion. A good measure of congestion is when average speeds are 30 MPH or less during the peak hour over a distance significant enough to encourage mode shifts from single occupant vehicles (SOVs) to HOVs and buses. An HOV lane may also be considered for a segment which initially could operate relatively smoothly with all mixed flow lanes, but for which congestion is predicted at some point in time after planned implementation of an HOV lane.

Traffic operations were analyzed for the years 1996 and 2006. The Authority's schedule for completion of its widening program between Interchanges 11 and 14 is 1996, so this year was used as the basis to forecast traffic conditions. The long-range demand was established at 10 years from 1996, or year 2006. Based on the analyses, the Turnpike segments shown below were reviewed for congestion ('Yes' denotes congestion).

Segment	**Forecast Congestion (PCEPL > 1,800)**			
Interch. to Interch.	1996 Peak Hour		2006 Peak Hour	
	AM	PM	AM	PM
8A to 11	No	No	No	No
11 to 14	No	No	Yes	Yes
14 to 16E	Yes*	Yes	Yes	Yes

Congestion is not forecast at any time between Interchanges 8A and 11. Between Interchanges 14 and 16E, traffic congestion is forecast during the PM peak hour in 1996. By year 2006, traffic congestion is forecast during both peak hours between Interchanges 11 and 16E.

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* Although the 1996 projected demand does not indicate traffic congestion during the AM peak hour between Interchanges 14 and 16E, congestion is currently experienced on the east spur ("southern mixing bowl" interchange north of Interchange 14 to Interchange 16E). This is due to the Authority's frequent shifting of traffic from the heavily congested west spur to the less congested east spur.

5.0 IDENTIFICATION OF MAINLINE HOV SCENARIOS

Mainline HOV lane scenarios were identified for possible application to the Turnpike between Interchanges 8A and 16E. Variations in HOV scenarios included:

- Use of lanes on the inner barrel roadway vs. the outer barrel roadway for HOV use
- Use of a single lane vs. two lanes vs. a combination of one and two lanes for HOV use
- Bus only HOV lane
- 2+ HOV lane designation
- 3+ HOV lane designation
- 2+ HOV and bus designation
- 3+ HOV and bus designation
- 2+ HOV, bus, and truck roadway
- 3+ HOV, bus, and truck roadway

Thirty-six scenarios involving the above combinations of HOV lane treatments and vehicle eligibility were analyzed along with the Do Nothing scenario. A multi-agency committee representing the New Jersey Turnpike Authority, the New Jersey Department of Transportation, and New Jersey Transit reviewed the analyses to short list the following HOV scenarios for further study:

- Single Lane Bus Only HOV
- Single Lane 3+ & Bus HOV
- Single Lane 3+ & Bus HOV Modified
- Combination 1 & 2 Lane 2+ & Bus HOV
- Inner Barrel 2+ & Bus HOV & Trucks

A description of each scenario follows.

- Single Lane Bus Only HOV

  This scenario involves designating a single lane for buses only from Interchange 8A to Interchange 16E.

- Single Lane 3+ & Bus HOV

  This scenario is identical to the above scenario except that the HOV lane designation would include vans and cars with three or more occupants in addition to buses.

- Single Lane 3+ & Bus HOV Modified

  This scenario modifies the above scenario by limiting the HOV lane to the Turnpike segment only between Interchanges 11 and 14. Construction in this segment will add one lane in each direction to the outer barrel roadway, thereby maintaining the existing number of general purpose traffic lanes.

- Combination 1 & 2 Lane 2+ & Bus HOV

  This scenario involves designating a single lane for HOVs from the roadway split south of Interchange 8A to Interchange 11, two lanes from Interchange 11 to Interchange 14, and a single lane of the east spur from the east-west spur split north of Interchange 14 to Interchange 16E. The HOV lane(s) would be designated for vans and cars with two or more occupants and buses.

- Inner Barrel 2+ & Bus HOV & Trucks

  This scenario allows trucks to mix with HOVs. It involves designating the 3-lane inner barrel roadway for 2+ HOVs, buses, and trucks from the roadway split south of Interchange 8A to Interchange 14. Beyond the east-west spur split, a single lane of the east spur would be designated for 2+ HOVs and buses.

6.0 VIABILITY OF HOV SCENARIOS

6.1 Viability Matrix

A matrix was developed to serve as a means of summarizing the viability of the HOV lane scenarios. The viability matrix is presented on page 12. The column headings are explained below.

Vehicle Throughput

The number of eligible vehicles to support an HOV lane before mode shift should be sufficient to obtain public acceptance of the HOV priority treatment. The minimum number of peak hour HOVs should be about 700 passenger car equivalents per lane (PCEPL) for a lane serving 2+ or 3+ HOVs and buses. Additionally, the number of peak hour HOVs should not be so great as to result in a level of service worse than the adjacent general purpose traffic lanes. Therefore, a volume of 1,600 PCEPL per hour was used as the upper limit for potential HOV lanes.

For a bus only lane or where buses are mixed with HOVs, the minimum number of HOVs can be reduced if there is a significant bus volume. A minimum of 100 buses was established as a criterion for this study.

Person Throughput

The major goal of an HOV lane is to improve the efficiency of a roadway by increasing its person moving capacity. For a lane to be designated for HOV use, the number of persons projected to use the HOV lane before mode shift should exceed the average number of persons per lane using the general purpose traffic lanes.

Travel Time Savings

An HOV lane should be considered only where it will provide travel time savings for HOV users compared to SOVs in the general purpose lanes. Analyses should indicate travel time savings before mode shifts of about one minute per mile, or a minimum 3-minute savings for the study corridor origin-destination pairs (i.e., each interchange to interchange movement). If this criterion is met, then mode shifts from SOVs to HOVs and buses are more likely to occur. The column in the table indicates if sufficient time savings will accrue HOV users before mode shift takes place.

Doesn't Take Away an Existing Lane

HOV lane projects accepted by commuters have been characterized by adding dedicated HOV lanes to the facility to increase vehicular capacity, rather than taking away an existing general purpose traffic lane for HOV use. There has not been a successful HOV lane project involving any significant length of freeway where an existing general purpose traffic lane was converted to an HOV lane. Therefore, in

assessing viability, an HOV lane is more likely to be accepted by the public when it involves adding capacity to the freeway corridor under consideration.

The issue of converting an existing general purpose traffic lane to an HOV lane is one of the most important issues confronting any HOV project. Converting an existing lane is seen as an inexpensive and less disruptive approach to implementing an HOV lane; i.e., it avoids the cost of adding a lane, potential right-of-way impacts, and disruption during construction. However, there have not been any successful HOV lane conversions involving a significant length of freeway. Reasons for failure on the few projects where lane conversion has been attempted are summarized below.

- Traffic congestion created in the general purpose lanes and on parallel facilities
- Insufficient HOV demand to obtain effective utilization of the HOV lane
- Perception that the HOV lane is serving very few vehicles (the "empty lane syndrome")
- Lack of support from the public and elected officials
- Lack of aggressive marketing and constituency building prior to and during lane conversion.

From the nationwide experience to date, it appears that it would be difficult for a lane conversion strategy to work. The only Turnpike HOV scenario that does not rely on lane conversion is the Single Lane 3+ & Bus HOV Modified scenario. All other scenarios under consideration include lane conversion. However, the Single Lane Bus Only and the Single Lane 3+ & Bus HOV scenarios do include one segment of the Turnpike (Interchange 11 to Interchange 14) where lane conversion is not required. A 'yes' entry in the matrix signifies that a general purpose lane is not taken away.

Doesn't Deteriorate Operations on General Purpose Lanes

If the general purpose lanes are required to carry significantly greater volumes of traffic after mode shift to HOVs compared to prior to HOV lane implementation, the level of service may deteriorate on these lanes. A 'yes' entry in the matrix signifies that the level of service will not deteriorate after mode shift.

6.2 Findings

For two scenarios -- Single Lane Bus Only HOV and Single Lane 3+ & Bus HOV -- there are insufficient HOVs to justify an HOV lane between Interchange 8A and 11. However, system and operational considerations may justify HOV lane limits that somewhat exceed viability limits (e.g.; to safely transition SOVs out of the HOV lane upstream of the actual viability limit). All scenarios, except for the Single Lane 3+ & Bus HOV Modified Scenario, require conversion of existing lanes from general purpose use to HOV use. Single lane HOV scenarios do not reduce the number of

general purpose traffic lanes between Interchanges 11 and 14 (except between the Interchange 13 exit and entrance ramps) because of the roadway widening presently under construction. Finally, the Combination 1 & 2 Lane 2+ & Bus HOV scenario will result in a deterioration in operations on the general purpose lanes between Interchanges 14 and 16E during the AM peak period. This is due to an insufficient number of HOVs estimated to use the HOV lanes to obtain a better overall balance of vehicles across all lanes.

NEW JERSEY TURNPIKE HOV STUDY

VIABILITY MATRIX

1996

HOV SCENARIO	NUMBER OF HOV LANES	STUDY SEGMENT INTERCHANGE LIMITS	VEHICLE THROUGHPUT		PERSON THROUGHPUT		TRAVEL TIME SAVINGS		DOESN'T TAKE AWAY AN EXISTING LANE	DOESN'T DETERIORATE OPERATIONS ON GENERAL PURPOSE LANES VERSUS DO NOTHING SCENARIO	
			AM	PM	AM	PM	AM	PM		AM	PM
SINGLE LANE BUS ONLY HOV	1	8A to 11	NO	NO	YES	YES	YES	YES	NO	YES	YES
	1	11 to 14	YES	YES	YES	YES			YES	YES	YES
	1	14 to 16E/18E	YES	YES	YES	YES			NO	YES	YES
SINGLE LANE 3+ & BUS HOV	1	8A to 11	NO	NO	YES	YES	YES	YES	NO	YES	YES
	1	11 to 14	YES	YES	YES	YES			YES	YES	YES
	1	14 to 16E/18E	YES	YES	YES	YES			NO	YES	YES
SINGLE LANE 3+ & BUS HOV MODIFIED	1	11 to 14	YES	YES	YES	YES	YES	YES	YES	YES	YES
COMBINATION 1 & 2 LANE 2+ & BUS HOV	1	8A to 11	YES	YES	YES	YES	YES	YES	NO	YES	YES
	2	11 to 14	YES	YES	YES	YES			NO	YES	YES
	1	14 to 16E/18E	YES	YES	YES	YES			NO	NO	YES
INNER BARREL 2+ & BUS HOV & TRUCKS	3	8A to 11	YES	YES	YES	YES	YES	YES	NO	YES	YES
	3	11 to 14	YES	YES	YES	YES			NO	YES	YES
	1	14 to 16E/18E	YES	YES	YES	YES			NO	YES	YES

7.0 EVALUATION OF HOV SCENARIOS

7.1 Evaluation Matrix

A matrix was developed as a means of quantifying and comparing the HOV scenarios after mode shift with the Do Nothing scenario. Two versions of the matrix were prepared; one for evaluating the AM peak hour and the other for the PM peak hour. The matrices are presented on pages 16 and 17. Column headings are described below.

HOV Lane Volume and V/C Ratio

This column presents the HOV volumes in terms of passenger car equivalents per lane (PCEPL) to determine expected HOV lane use. The volume to capacity (V/C) ratio is a measure of operations in the HOV lane. V/C ratios over 0.93 represent congestion, ratios between 0.77 and 0.93 represent impeded traffic flow, ratios between 0.55 and 0.77 represent uncongested conditions, and ratios less than 0.35 represent free flow conditions.

General Purpose Lane Volume and V/C Ratio

General purpose (GP) lane volumes in PCEPL and V/C ratios are listed for each HOV scenario and the Do Nothing scenario. A comparison of the figures for the HOV scenarios to the Do Nothing scenario give an indication if and to what extent there may be deterioration of operations in the GP lanes after implementation of an HOV scenario. V/C ratios are as defined above.

Difference in HOV Scenario Vehicle Travel Times Versus Do Nothing Scenario

Positive travel time differences in minutes represent shorter trip times while negative differences represent longer trip times.

Difference in HOV Scenario Person Travel Times Versus Do Nothing Scenario

In general, it is expected that people traveling in the general purpose lanes will experience greater travel times under HOV scenarios compared to the Do Nothing scenario, while people traveling in the HOV lane will experience shorter travel times compared to the Do Nothing scenario. However, because of the greater people carrying capacity of an HOV lane, there should be a net improvement in person travel times for HOV scenarios.

Person Throughput

The total numbers of people carried in the HOV lanes and the general purpose lanes are listed for each HOV scenario and the Do Nothing scenario.

Number of Take Away General Purpose Lanes

Additional capacity is being added to the Turnpike between Interchanges 11 and 14 -- one lane in each direction along the outer barrel roadway. Use of one lane on the outer barrel between these interchanges for an HOV lane represents the segment where the number of existing general purpose lanes remains unchanged if an HOV scenario is implemented.

Degree of Operational Difficulty

Operational considerations include the ability to manage traffic volumes between the inner and outer barrel roadways and between the east-west spurs, and to safely access the HOV lanes, the inner and outer barrel roadways at their split, and the east and west spurs at their split (the "southern mixing bowl"). The degree of operational difficulty (low, medium, high) compared to the Do Nothing scenario refers to the ability to access HOV lanes at roadway splits, to manage flows between dual roadways, to safely mix trucks with HOVs, and to easily sign HOV lanes. Some specific operational considerations relating to HOV scenarios include:

- Restrictive use of one lane, two lanes, or an entire barrel
- Trucks must weave left to enter the inner barrel roadway south of Interchange 8A (Inner Barrel scenario)
- Trucks on the inner barrel roadway must merge into the east spur from the left (Inner Barrel scenario)
- Toll booths must be reconfigured during peak periods to move trucks to the left to access the inner barrel roadway ramp (Inner Barrel scenario)

7.2 Air Quality

New Jersey is required by the federal Clean Air Act Amendments to reduce air pollution emission levels by 565 tons per day by the year 2005. Mandated steps will reduce emission levels by 382 tons per day, leaving a shortfall of 183 tons. Strategies to provide reductions must be included in a State Implementation Plan to be submitted to the U.S. Environmental Protection Agency in November 1993. HOV lanes can result in reducing emission levels.

Air quality impacts for the various HOV scenarios were estimated for carbon monoxide (CO), hydrocarbon (HC), and Nitrogen Oxide (NOx) components of vehicle exhaust emissions. Differences in emissions for each HOV scenario compared to the Do Nothing scenario were calculated on the basis of the changes in vehicle miles of travel and emission factors based on travel speeds along the Turnpike. Differences in vehicle emissions for the AM and PM peak periods as well as on a daily basis are presented in the following table.

REDUCTION IN VEHICLE EMISSIONS (TONS)

COMPARED TO THE DO NOTHING SCENARIO

HOV SCENARIO	6-9 AM	4-7 PM	DAILY
Hydrocarbons			
Single Lane Bus Only HOV	0.049	0.191	0.240
Single Lane 3+ & Bus HOV	0.025	0.107	0.132
Single Lane 3+ & Bus HOV Modified	0.006	0.031	0.037
Combination 1 & 2 Lane 2+ & Bus HOV	-0.003	0.053	0.050
Inner Barrel 2+ & Bus HOV & Trucks	0.010	0.055	0.065
Carbon Monoxide			
Single Lane Bus Only HOV	0.396	1.730	2.126
Single Lane 3+ & Bus HOV	0.164	0.837	1.001
Single Lane 3+ & Bus HOV Modified	0.031	0.200	0.231
Combination 1 & 2 Lane 2+ & Bus HOV	-0.100	0.366	0.266
Inner Barrel 2+ & Bus HOV & Trucks	0.103	0.519	0.622
Nitrogen Oxides			
Single Lane Bus Only HOV	-0.014	-0.017	-0.031
Single Lane 3+ & Bus HOV	-0.007	-0.012	-0.019
Single Lane 3+ & Bus HOV Modified	0.010	0.004	0.014
Combination 1 & 2 Lane 2+ & Bus HOV	0.068	0.016	0.084
Inner Barrel 2+ & Bus HOV & Trucks	-0.058	-0.019	0.077
Note - A negative number represents a disbenefit compared to the Do Nothing Scenario			

7.3 Change in Revenue

After mode shift, there is likelihood of a loss in revenue for the HOV scenarios compared to the Do Nothing scenario as motorists join carpools and switch to buses. The estimated annual (1996) loss in revenue as a result of mode shift for each HOV scenario relative to the Do Nothing scenario is tabulated below. This loss may turn out less than estimated as vehicles on parallel routes may divert to the Turnpike due to the attractiveness of the HOV lane or the resulting overall improvement in traffic operations.

HOV Scenario	Estimated Annual Revenue Reduction
Single Lane Bus Only HOV	$5,400,000
Single Lane 3+ & Bus HOV	2,300,000
Single Lane 3+ & Bus HOV Modified	600,000
Combination 1 & 2 Lane 2+ & Bus HOV	1,000,000
Inner Barrel 2+ & Bus HOV & Trucks	1,200,000

NEW JERSEY TURNPIKE HOV STUDY

EVALUATION MATRIX

1996 NORTHBOUND AM PEAK HOUR AFTER MODE SHIFT

HOV SCENARIO	NUMBER OF HOV LANES	NUMBER OF GENERAL PURPOSE LANES	STUDY SEGMENT INTERCHANGE LIMITS	TYPICAL HOV VOLUME AND V/C RATIO		TYPICAL GENERAL PURPOSE VOLUME AND V/C RATIO		DIFFERENCE IN HOV SCENARIO VEHICLE TRAVEL TIMES VERSUS DO NOTHING SCENARIO		DIFFERENCE IN HOV SCENARIO PERSON TRAVEL TIMES VERSUS DO NOTHING SCENARIO		TOTAL PERSON THROUGHPUT		NUMBER OF TAKEAWAY G.P. LANES	DEGREE OF OPERATIONAL DIFFICULTY
				PCEPL	V/C	PCEPL	V/C	HOV	G.P.	HOV	G.P.	HOV	G.P.		
SINGLE LANE BUS ONLY HOV	1	4/5	8A to 11	90	0.05	1080	0.54	3.94	−0.04	8840	−220	2240	5400	1	LOW
	1	6	11 to 14	330	0.16	1410	0.70	2.33	0.00	19090	0	8190	8800	0	LOW
	1	2	14 to 16E/18E	330	0.16	1240	0.62	0.83	0.04	6730	120	8110	2940	1	LOW
SINGLE LANE 3+ & BUS HOV	1	4/5	8A to 11	250	0.13	1090	0.54	2.62	−0.04	6690	−200	2550	5110	1	LOW
	1	6	11 to 14	670	0.33	1410	0.71	1.88	0.00	16690	0	8880	8120	0	LOW
	1	2	14 to 16E/18E	520	0.26	1240	0.62	0.75	0.04	6300	100	8400	2580	1	LOW
SINGLE LANE 3+ & BUS HOV MODIFIED	0	5/6	8A to 11	N/A	N/A	970	0.49	N/A	0.49	N/A	3750	N/A	7650	0	N/A
	1	6	11 to 14	630	0.32	1500	0.75	1.82	−0.03	15220	−280	8360	9160	0	LOW
	0	3	14 to 16E/18E	N/A	N/A	1330	0.66	N/A	0.00	N/A	0	N/A	11080	0	N/A
COMBINATION 1 & 2 LANE 2+ & BUS HOV	1	4/5	8A to 11	1000	0.50	950	0.48	0.43	0.03	1680	110	3900	3740	1	LOW
	2	5	11 to 14	900	0.45	1560	0.78	1.34	−0.85	14300	−5370	10670	6310	1	MEDIUM
	1	2	14 to 16E/18E	980	0.49	1390	0.70	0.38	−0.83	3280	−2000	8640	2410	1	LOW
INNER BARREL 2+ & BUS HOV & TRUCK	3	2/3	8A to 11	800	0.40	930	0.52	1.05	−0.04	5180	−110	4930	2700	3	HIGH
	3	4	11 to 14	1250	0.62	1370	0.68	0.54	−0.41	6480	−2030	12010	4960	3	HIGH
	1	2	14 to 16E/18E	1000	0.50	1330	0.66	0.38	0.02	3460	40	9110	1900	1	HIGH
DO NOTHING	0	5/6	8A to 11	N/A	N/A	1010	0.51	N/A	N/A	N/A	N/A	N/A	7650	N/A	N/A
	0	7	11 to 14	N/A	N/A	1480	0.74	N/A	N/A	N/A	N/A	N/A	17000	N/A	N/A
	0	3	14 to 16E/18E	N/A	N/A	1400	0.70	N/A	N/A	N/A	N/A	N/A	11030	N/A	N/A

NOTES:

PCEPL – Passenger Car Equivalents Per Lane
V/C – Volume to Capacity Ratio
G.P. – General Purpose
N/A – Not Applicable
Travel Time Measured in Minutes
Person Travel Time Measured in Total Person Minutes
Negative Number Shows a Disbenefit When Compared to the Do Nothing Scenario

NEW JERSEY TURNPIKE HOV STUDY

EVALUATION MATRIX

1996 SOUTHBOUND PM PEAK HOUR AFTER MODE SHIFT

HOV SCENARIO	NUMBER OF HOV LANES	NUMBER OF GENERAL PURPOSE LANES	STUDY SEGMENT INTERCHANGE LIMITS	TYPICAL HOV VOLUME AND V/C RATIO		TYPICAL GENERAL PURPOSE VOLUME AND V/C RATIO		DIFFERENCE IN HOV SCENARIO VEHICLE TRAVEL TIMES VERSUS DO NOTHING SCENARIO		DIFFERENCE IN HOV SCENARIO PERSON TRAVEL TIMES VERSUS DO NOTHING SCENARIO		TOTAL PERSON THROUGHPUT		NUMBER OF TAKEAWAY G.P. LANES	DEGREE OF OPERATIONAL DIFFICULTY
				PCEPL	V/C	PCEPL	V/C	HOV	G.P.	HOV	G.P.	HOV	G.P.		
SINGLE LANE BUS ONLY HOV	1	4/5	8A to 11	80	0.04	1000	0.50	3.15	−0.01	6120	−50	1940	5290	1	LOW
	1	6	11 to 14	230	0.12	1380	0.69	4.08	0.49	23580	4670	5780	9530	0	LOW
	1	2	14 to 16E/18E	250	0.12	1600	0.80	8.17	4.31	50430	18960	6170	4400	1	LOW
SINGLE LANE 3+ & BUS HOV	1	4/5	8A to 11	380	0.19	1000	0.50	1.46	−0.01	3810	−50	2610	4630	1	LOW
	1	6	11 to 14	840	0.42	1360	0.68	2.02	0.50	14510	4070	7180	8140	0	LOW
	1	2	14 to 16E/18E	740	0.37	1470	0.73	7.74	6.62	57420	20970	7420	3170	1	LOW
SINGLE LANE 3+ & BUS HOV MODIFIED	0	5/6	8A to 11	N/A	N/A	930	0.46	N/A	0.04	N/A	290	N/A	7220	0	N/A
	1	6	11 to 14	780	0.39	1490	0.74	1.81	0.00	11670	0	6450	9150	0	LOW
	0	3	14 to 16E/18E	N/A	N/A	1700	0.85	N/A	3.99	N/A	42410	N/A	10630	0	N/A
COMBINATION 1 & 2 LANE 2+ & BUS HOV	1	4/5	8A to 11	1060	0.53	890	0.44	−0.03	0.07	−110	240	3750	3450	1	LOW
	2	5	11 to 14	1130	0.57	1450	0.73	1.24	0.00	11710	0	9440	5820	1	MEDIUM
	1	2	14 to 16E/18E	1500	0.75	1420	0.71	6.62	6.64	54440	15670	8220	2360	1	LOW
INNER BARREL 2+ & BUS HOV & TRUCK	3	2/3	8A to 11	790	0.39	1070	0.54	0.47	−0.49	2090	−1360	4440	2780	3	HIGH
	3	4	11 to 14	1410	0.70	1300	0.65	0.32	0.62	3360	2960	10490	4770	3	HIGH
	1	2	14 to 16E/18E	1500	0.75	1410	0.70	6.62	6.64	57900	12400	8750	1870	1	HIGH
DO NOTHING	0	5/6	8A to 11	N/A	N/A	990	0.50	N/A	N/A	N/A	N/A	N/A	7420	N/A	N/A
	0	7	11 to 14	N/A	N/A	1480	0.74	N/A	N/A	N/A	N/A	N/A	15290	N/A	N/A
	0	3	14 to 16E/18E	N/A	N/A	1810	0.91	N/A	N/A	N/A	N/A	N/A	10630	N/A	N/A

NOTES:

PCEPL – Passenger Car Equivalents Per Lane
V/C – Volume to Capacity Ratio
G.P. – General Purpose
N/A – Not Applicable
Travel Time Measured in Minutes
Person Travel Time Measured in Total Person Minutes
Negative Number Shows a Disbenefit When Compared to the Do Nothing Scenario

8.0 HOV OPERATIONAL CONSIDERATIONS

Within each HOV scenario there are a number of operational considerations that help to define the HOV scenarios. Some of these considerations involve issues that can be addressed now, while others cannot be addressed until a scenario is determined to be viable and worthy of additional study. These issues include:

- Limits of Corridor
- Barrier Separated vs. Contiguous HOV Lane
- HOV Lane Access
- Lane Orientation
- Hours of Operation
- Enforcement
- Safety
- Traffic Management

8.1 Limits of Corridor

The study limits are Interchange 8A on the south and Interchange 16E on the north. These limits were selected on the basis of traffic volumes; i.e., the limits cover the portion of the Turnpike serving heavy volumes of commuter traffic with origins and destinations in central and northern New Jersey and the New York City metropolitan area. Within these limits, the corridor was segmented on the basis of the physical roadway system. The segments are:

- Interchange 8A to Interchange 11

  Between Interchanges 8 and 8A, the 3-lane roadway splits to create the inner and outer barrel roadway system. The roadway transitions to a 3-lane inner barrel and 2-lane outer barrel roadway system , with trucks restricted to the outer roadway. At Interchange 9, the outer roadway picks up another lane. From Interchange 9 to Interchange 11, both inner and outer barrel roadways are each three lanes.

- Interchange 11 to Interchange 14

  Between these limits, a fourth lane is under construction along the outer roadway. However, the lane will not be constructed at Interchange 13 between the on and off ramps due to physical constraints. The fourth lane is scheduled for completion in 1996.

- Interchange 14 to Interchange 16E

  North of Interchange 14, the Turnpike transitions from an inner-outer barrel roadway system to an east-west spur system. The interchange between the systems is called the "southern mixing bowl." The west spur primarily serves northern New Jersey and the George Washington Bridge, while the east spur primarily serves the Lincoln Tunnel and the Hudson River Waterfront. Both spurs are each three lanes in each direction and serve all classes of vehicles.

8.2 Barrier Separated vs. Contiguous HOV Lane

A barrier separated facility can be a safer and easier method for operating and enforcing an HOV lane than a contiguous HOV lane. However, it is generally more expensive to construct, it presents problems for incident management, and it restricts flexibility in operating the Turnpike as a whole.

A contiguous HOV lane is generally less expensive to implement and it allows greater flexibility of Turnpike operation. The HOV scenarios were evaluated assuming the HOV lanes are contiguous with the general purpose traffic lanes.

8.3 HOV Lane Access

Access to and from an HOV lane either could be continuous or designated at selected areas. Continuous access (i.e., access into and out of the HOV lane at any location) tends to make HOV lane enforcement more difficult. Designated access concentrates access at selected areas by the use of lane striping between the HOV lane and the adjacent general purpose lane. This type of access may not be as safe or as operationally efficient as continuous access, but it tends to make HOV lane enforcement easier. This issue must be addressed upon selection and development of a preferred HOV scenario.

8.4 Lane Orientation

A freeway HOV lane can be designated as the right lane or the left lane. The advantages and disadvantages of each are listed below.

<u>Left Lane Orientation</u>

Advantages:

- The HOV lane would be the high-speed lane
- HOVs would not be mixed with trucks
- Consistent with other HOV projects planned in New Jersey (I-80 and I-287)

Disadvantages:

- Vehicles must access the lane by crossing all the general purpose lanes unless ramps or crossovers directly accessing the HOV lane are constructed

Right Lane Orientation

Advantages:

- Easy to access at interchanges directly from existing ramps

Disadvantages:

- Trucks would be precluded from the right lane
- Travel time savings for HOVs could be lost at ramp merging areas
- Safety may be compromised by mixing faster moving HOVs with slower moving SOVs and trucks accelerating or decelerating at ramp merge areas
- Difficult to enforce because entering and exiting SOVs must use the lane in the vicinity of interchanges

8.5 Hours of Operation

The candidate HOV lane operating periods were nominally identified as 6 AM to 9 AM for northbound traffic and 4 PM to 7 PM for southbound traffic. It was determined from traffic data and counts along with observations that heavy traffic volumes are evidenced within these periods. These hours of operation should result in sufficient demand for the HOV lanes. With projected future growth, it is expected that traffic volumes will increase within these periods. Outside of the peak periods, traffic demands decrease, making HOV lanes unwarranted during off-peak periods. Thus, HOV lanes should revert to general purpose traffic lanes outside of the candidate operating periods. If an HOV scenario is selected for implementation, operating periods need to be reassessed in subsequent study stages and also immediately prior to HOV lane opening.

8.6 Enforcement

Enforcement of the HOV lane could be handled by providing enforcement areas at ramp entrances to the lane or along the lane. If direct access ramps are to be included in an HOV scenario, the ramps could be designed, if feasible, with sufficient width to pull over violators. Enforcement along the HOV lane could be handled through the use of a widened left shoulder. Where it is impractical to provide a continuous wide left shoulder due to obstructions such as bridge parapets, bridge

piers, and sign supports, it is desirable to widen the shoulder at intervals of 2 to 3 miles.

8.7 Safety

Any HOV scenario selected for implementation must undergo rigorous examinations of its physical and operational features during the design and development stages to ensure that safety along the Turnpike is not compromised. Some of these features may include:

- Lane and shoulder widths
- Use of shoulders
- Mix of trucks, buses, and cars
- Access provisions and merge and diverge areas
- Creation of weaving movements
- Sign locations, legends, and structure types
- Location of enforcement areas
- Operation of enforcement activities
- Provisions for incident management

Upon implementation of an HOV scenario, follow-up studies must be done to periodically monitor safety of the HOV lanes and the Turnpike roadways along the HOV lane corridor.

8.8 Traffic Management

The Turnpike Authority is presently investing in upgrading its Automatic Traffic Surveillance and Control (ATSC) System to further improve its ability to manage traffic congestion and respond to traffic incidents as well as safely and efficiently accommodate maintenance requirements. Recommendations for implementation of HOV lanes must be integrated into the ATSC system because of:

- HOV lane and overall roadway traffic and incident management
- Variable message signing and motorist information
- Maintenance and construction activities
- Toll plaza operations and future provisions for electronic toll collection (ETC)

9.0 ASSESSMENT OF HOV SCENARIOS

In addition to the evaluations presented in the matrices, the advantages and disadvantages of each HOV scenario are summarized below.

- Single Lane Bus Only HOV

  Advantages:

  - Provides significant time savings for the bus commuters
  - Provides greatest mode shift potential
  - Easy to enforce in terms of identifying violators

  Disadvantages:

  - Takes away a general purpose traffic lane between Interchanges 8A and 11 and between Interchanges 14 and 16E
  - HOV lane would be underutilized south of Interchange 11
  - Encourages violations due to lane underutilization
  - Greatest loss in revenue due to potential mode shifts

- Single Lane 3+ & Bus HOV

  Advantages:

  - Provides good time savings for HOV and bus users
  - Provides good mode shift potential

  Disadvantages:

  - Takes away a general purpose traffic lane between Interchanges 8A and 11 and between Interchanges 14 and 16E
  - HOV lane would be underutilized south of Interchange 11
  - Encourages violations due to lane underutilization south of Interchange 11
  - Moderate loss in revenue due to potential mode shifts

- Single Lane 3+ & Bus HOV Modified

  Advantages:

  - Only scenario that does not take away a general purpose traffic lane
  - Provides modest time savings for HOV and bus users
  - Provides modest mode shift potential

Disadvantages:

- Some loss in revenue due to potential mode shifts

- Combination 1 & 2 Lane 2+ & Bus HOV

  Advantages:

  - Provides modest time savings for HOV and bus users
  - Provides modest mode shift potential

  Disadvantages:

  - Takes away a general purpose traffic lane from Interchange 8A to Interchange 16E
  - Modest loss in revenue due to potential mode shifts
  - Negative impact on general purpose vehicle travel times
  - Medium operational difficulty

- Inner Barrel 2+ & Bus HOV & Trucks

  Advantages:

  - Provides good time savings for HOV and bus users
  - Provides good mode shift potential

  Disadvantages:

  - Takes away three general purpose lanes between Interchanges 8A and 14 and one general purpose lane between Interchanges 14 and 16E
  - Greatest negative impact on general purpose traffic travel times
  - Modest loss in revenue due to mode shift
  - High operational difficulty
  - Presence of trucks may discourage HOVs from using the inner barrel
  - Requires difficult truck maneuvers

10.0 CONCLUSION

All HOV scenarios appear to be operable, albeit at varying levels of operational difficulty and with different impacts on the general purpose lanes. Viability appears to be borne out for consideration of a single HOV lane between Interchanges 11 and 14. Before any commitments can be made, however, more detailed analyses must be performed regarding capital and operation costs, geometrics, access and egress, enforcement, and safety. As a toll facility, HOV treatments on the Turnpike need to address several issues not encountered on free controlled access facilities. They are:

- Toll plaza operations and advanced technology for electronic vehicle detection and toll collection
- Integration of toll plaza operations with operations on the mainline roadways of the Turnpike
- Revenue impacts
- Turnpike Automatic Traffic Surveillance and Control (ATSC) System

The New Jersey Turnpike is a unique facility in terms of both its design and especially its operation. Potential HOV treatments must be compatible with the unique characteristics of the facility and in conformance with the policies and requirements of the New Jersey Turnpike Authority.

and associates, inc.

August 10, 1993

Mr. Donald L. Watson
Executive Director
New Jersey Turnpike Authority
P.O. Box 1121
New Brunswick, New Jersey 08903

Dear Mr. Watson,

My review and assessment of the proposal to implement and operate High Occupancy Vehicle (HOV) lane(s) on the New Jersey Turnpike has been completed. A detailed report of the study which sets forth my conclusions and recommendations is being forwarded under separate cover.

This letter is for the purpose of providing a summary of the report, and, in particular, to inform you of my conclusions and recommendations.

During the study, I made a thorough review of those factors relating to the present operation of the Turnpike, considered a number of aspects regarding the implementation and operation of HOV lanes on operating freeways, and made an assessment of several alternative lane configurations and operating conditions of HOV lanes on the Turnpike. Throughout the process, I relied heavily upon lessons learned from my personal experience in implementing and operating HOV lanes in Southern California as well as the experiences of others on HOV projects throughout the nation.

I have concluded that the concept of implementing and operating one HOV lane in each direction on the New Jersey Turnpike is feasible.

If HOV lanes are implemented, the following points are recommended:

- The HOV lane be situated in the left lane of either the Inner or Outer Roadways. If designs can be developed, designation of the left lane of the Outer Roadway, with direct connections via the Inner Roadway ramps and cross-overs offers distinct operational advantages.
- HOV's with occupancy of 3-or-more persons be designated as eligible to use the lane.

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- HOV lanes be implemented in conjunction with the addition of lanes to the Turnpike.
- Enforcement areas, adjacent to HOV lanes, and enforcement operations be included as a part of the project.
- Significant public/community support for the project is in place before implementation.

I would emphasize that my conclusions and recommendations are necessarily held at the conceptual level; I cannot give an unqualified professional recommendation, at this time, that HOV lanes be placed into operation on the Turnpike. Several questions need to be answered before that can be done, questions to do with design feasibility, safety and operational needs, the availability of space in which to construct facilities, enforcement considerations, costs, and the level of community support. These can only be answered with the development of preliminary designs and cost estimates, and through development of support for the project.

Until answers to these questions are developed, I cannot recommend with any degree of certainty that HOV lanes can or should be implemented and operated on the Turnpike.

Yours truly,

David H. Roper
President

and associates, inc.

August 9, 1993

Mr. Donald L. Watson
Executive Director
New Jersey Turnpike Authority
P.O. Box 1121
New Brunswick, New Jersey 08903

Dear Mr. Watson,

I have completed a comprehensive review of proposals to implement and operate High Occupancy Vehicle (HOV) lanes on the New Jersey Turnpike. This letter is for the purpose of reporting upon my review, of offering my thoughts about various aspects of HOV lane implementation and operation, and of presenting my conclusions and recommendations relative to such an operation on the Turnpike.

My review included a detailed look at both current and projected traffic flows, the modal-mix with the traffic stream, current and future capacities on the facility, and the traffic management systems and strategies being used to facilitate the flow of traffic and improve safety on the Turnpike.

In reviewing traffic flows, I focused attention on the following volumes and traffic mix, anticipated in 1996, the year in which it has been proposed that HOV lane(s) be put into operation.

ELIGIBLE USERS OF HOV LANE(S)	1996 PEAK HOUR VOLUMES N.B.-A.M.		S.B.-P.M.	
	Modal Shift With	W/O	With	W/O
3+ & Bus	800	700	1,000	900
2+ & Bus	2,200	2,100	2,800	2,700
Bus Only	400	300	300	200
2+ & Bus & Truck	4,400*	4,200*	4,500*	4,400*

* Three Lane Inner Roadway

As I assessed various aspects of HOV treatments, I relied

heavily upon "lessons learned" from experience with HOV lane(s) in a host of locations throughout the nation, and applied these to the New Jersey Turnpike setting as I understand it. I have recorded my thoughts related to these aspects and to HOV implementation and operation on the Turnpike.

One Lane/Two Lanes

- Calls for "Take-A-Lane-Away"
- Too much too soon? Need for progression into the use of HOV lanes
- Will result in per lane volume of 1,100 to 1,400 for 2^+ & Bus
- Discontinuity at North end

Inner Roadway/Outer Roadway

- Not much difference operationally
- Adding lane to Outer Roadway; therefore, if on Inner Roadway, could be viewed as being "Take-A-Lane-Away"
- Trucks are on Outer Roadway and using much capacity; therefore, better to place HOV's on Inner Roadway
- Perception that Inner Roadway is "better"; therefore, is best to place HOV's on Inner Roadway

Left Lane/Right Lane

- Left Lane .. no conflicts with on/off ramps
  .. calls for weaves from/to ramps
  .. calls for ingress/egress points (or continuous) for HOV's to enter/leave HOV lane
- Right Lane .. conflicts with on/off ramps; introduces weaving movements

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.. direct access from on/off ramps

.. need ingress/egress points (or continuous) to/from ramps for general purpose traffic

.. Trucks are in right lanes of Outer Roadway; would "surround" HOV's

Part Time/Full Time

- Lane becomes available for use by general purpose traffic during off-peak periods

... but ...

- Don't need extra capacity for general purpose traffic during periods of no congestion
- Provides greater flexibility (more lanes) during off-peak for traffic management/ balancing flows
- Introduces potential for confusion on part of motorists (Is it HOV or not?)
- Calls for real-time signing capability

Ingress/Egress

- Best if direct connections can be provided; avoids need for lane-change moves between general purpose and HOV lanes
- If definitive ingress/egress lane-change points are established, can control where these moves take place and avoid indiscriminate crossings; develops a driver awareness/ expectation at these locations

... but ...

- creates a concentration of these moves at limited number of points; better to let drivers pick their own locations
- Definitive points of egress call for unique signing placed well in advance of off ramps

Enforcement

- Absolutely essential to insure successful operation
- Need well designed, safe locations to carry out enforcement activities
- Avoid enforcement operation which calls for weaving violator across general purpose lanes

Public/Community Support

- Absolutely essential if operation is to be successful
- Need comprehensive public awareness program to develop; it doesn't just happen
- It takes time, especially on initial/early projects

Impacts of Unsuccessful Project

- Can cause serious set-back to overall HOV program (Ref.: Santa Monica Freeway, Route 55 Freeway, Garden State Parkway)
- Need successful project in New Jersey

Conversion of Existing Lane (Take-A-Lane-Away)

- Expect public/political pressure for aborting project; intense if general purpose lanes are congested, perhaps less intense (but still there) if no congestion
- Motivation for modal shift (ie., by-passing congestion) does not exist if general purpose lanes are not congested

With these points in mind, I examined the four alternates of eligible users of the HOV lane(s) presently being carried in the Parsons Brinckerhoff study.

Bus Only

- Very low vehicular volumes; vulnerable to "Empty Lane Syndrome" criticism
- Very inefficient use of capacity in corridor
- Given funding issues in transit agencies, unlikely that significant growth in volumes will occur

2+ & Bus & Truck (Entire Inner Roadway)

- Good volumes, demand and capacity are well matched
- Introduces all trucks into Inner Roadway instead of normal location in outside lanes of Outer Roadway
- Mixes HOV's (carpools) with trucks
- Perception that Inner Roadway is "better" and that trucks belong in Outer Roadway
- Inner Roadway no longer available to balance traffic flows; in effect, takes Traffic Management System out of service

3+ & Bus

- Volumes on low side, although probably high enough to avoid perception of "Empty Lane"
- Have excess capacity in HOV lane; provides room for growth in HOV usage

2+ & Bus

- Volumes too high to be accommodated in one lane
- Expectation that free-flow in HOV lane would not be achieved

As the review progressed, an alternative HOV lane config-

uration, which is a hybrid of those currently being considered, was identified; it is one which offers several potential advantages over those schemes presently under study. In this plan, the left lane of the Outer Roadway would be operated as the HOV lane, with ingress/egress to the HOV lane being provided through use of the existing on and off ramps to the Inner Roadway and newly constructed HOV-only cross-overs of the separating strip between the Inner and Outer Roadways. I've listed my thoughts relative to this alternative:

- Provides direct connections for ingress/egress; no weaving movements across general purpose lanes
- Allows for establishing striped "barrier" between HOV lane and general purpose lanes during hours of HOV lane operation
- Barrier striping could become "O.K. to Cross" during hours of non-HOV operation; lane is available for general purpose use and optimization of traffic management capabilities
- Calls for left-hand on and off ramps to/from HOV lane
- Places HOV lane in left lane of roadway; no interference with existing on/off ramps
- Needs space for development of cross-overs, ramp configurations, and enforcement areas
- Opportunity to implement ramp-metering of HOV on-ramps
- Calls for real-time signing and ramp-closure systems
- Places HOV lane on Outer Roadway, where lane is being added; is <u>not</u> "Take-A-Lane-Away"

CONCLUSIONS/RECOMMENDATIONS

I strongly suggest that the policies for the implementation and operation of HOV lanes on any operating freeway be

developed around three principles:

- Operate the lanes such that essentially free-flow conditions are maintained on the HOV lanes.
- When considering which HOV's are eligible to use the lanes, always opt in favor of the higher occupancy vehicles.
- Avoid "taking a lane" (or even creating the perception of same) to create the HOV lane.

In addition, in the case of the New Jersey Turnpike, I recommend that special consideration be given to preserving the operational integrity of the Traffic Management System, upon which the successful operation of traffic within the Turnpike corridor is so dependent.

Based upon my review, it is my opinion that the concept of implementing and operating one HOV lane in each direction of the New Jersey Turnpike is feasible .... volumes of HOV's with occupancy of 3-or-more are adequate to reasonably fill the lane while at the same time maintaining free-flow; general purpose lanes are presently experiencing some congestion and traffic volumes will undoubtedly grow to cause even greater congestion in the future; peaking characteristics of traffic clearly link the recurrent traffic congestion problem to the commuter trips.

As to the when and where of implementation, these should be linked to the addition of lanes on the Turnpike. With the construction of additional lanes currently underway between Interchanges 11 and 14, this reach is a natural candidate for the introduction of HOV lanes onto the Turnpike, if the HOV operation is undertaken.

HOV lanes could be operated equally effectively if they were placed in the left lanes of either the Inner Roadway or the Outer Roadway, providing adequate enforcement areas could be developed next to the lanes. The alternative of using the ramps to/from the Inner Roadway and cross-overs to provide for direct ingress and egress offers many operating advantages, if designs can be developed.

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I cannot, at this time, make a firm professional recommendation as to implementing an HOV operation on the New Jersey Turnpike. There are too many unanswered questions to make such a recommendation. These include questions of the design feasibility of various options, whether space for necessary design features exists or can be reasonably developed, assessment of safety and operational impacts of the various configurations and designs, enforcement considerations, and, of course, determination of costs of both implementation and operation. It is only possible to provide answers to these questions through a preliminary, yet fairly detailed, design of the various alternative projects.

Another unknown at this time, and one which experience elsewhere has shown to be absolutely critical if any HOV project is to be successful, is the level of community support for placing HOV lanes on the Turnpike. Steps to assess the level of support need to be undertaken, and an assertive program to develop essential support needs to be conducted, before a decision can be made to definitely move forward with implementation of any HOV project.

I have appreciated the opportunity to have worked with you and your staff in this assessment of HOV lanes on the New Jersey Turnpike. I particularly appreciate the open, constructive, and professional atmosphere in which the review and discussions were conducted.

If you have any questions regarding this matter, or if you desire additional information, please contact me.

Yours truly,

David H. Roper

David H. Roper
President